

Taxonomic Review of Genus *Bombus* (Hymenoptera, Apidae) from Korea

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Abstract Seventeen species of the genus *Bombus* are recognized from Korea. Among them, *B. (Tricornibombus) atripes* Smith is reported for the first time from the Korean peninsula, and *B. (Thoracobombus) humilis subbaicalensis* Vogt is new to the fauna of South Korea. Keys to seven subgenera and 21 Korean species, a geographical list of collection data, and host flowers of each species are given.

Key words Systematics, *Bombus*, Apidae, Hymenoptera, Korea

INTRODUCTION

Bumblebees are familiar insects because of their large size, colourful hairs and their flower-visiting behavior. In the recent years, their considerable role as crop plant pollinators is being recognized more and more by farmers worldwide: *Bombus terrestris*, *B. impatiens*, *B. occidentalis* and *B. californicus* have been widely used for greenhouse vegetables and open field crops in many countries, and some of them are mass-reared commercially. In Korea, a commercial bumblebee, *Bombus terrestris*, have been imported from Europe since 1993, and used for the various crops in the greenhouse. There is an urgent need to find a good candidate and to develop mass-rearing technique of the selected species, among the indigenous bumblebee species of Korea for the crop pollination.

Bumblebees are very scarce or even absent in the southern hemisphere and in tropical regions, but they are abundant in the temperate parts of the Palearctic and Nearctic regions. For example, 21 species are known in England (Alford, 1975) as well as in Japan (including 7 subspecies) (Hirashima, 1989). In Korea, since Radoszkowski (1887) described *Bombus koreensis* Radoszkowski, and *B. lapidarius* var. *kalinowski* Radoszkowski, many other species have been reported by Uchida (1925), Skorikov (1933), Bischoff (1936), Doi (1938) and Kim (1963), Tkalcu (1965), Ku (1968) and Sakagami et Ishikawa (1969) until 1974. Some of them, however, have been erroneously known with misidentification and synonymized. Recently, Sakagami (1975) and Ito (1985) added nine species new to the Korean peninsula, based on the North Korean specimens collected by the expedition of the Hungarian Natural

History Museum in 1971 (Papp and Horvatovich, 1972), and recently Kim et Kim (1993) described a subspecies, *Bombus ardens ullungensis*. In Checklist of insects from Korea (1994), 20 *Bombus* species are listed, of which 20 species were reported from North Korea and 15 species from South Korea.

The aim of this study is to contribute to the knowledge of the bumblebees of Korea and provide keys to species for identification. Keys are mainly based on female characters. Additionally, the scientific name of host flowering plants are listed.

MATERIAL AND METHODS

A total of 1,548 bumblebee specimens collected from the Korean Peninsula was examined for this study, which preserved in the Insect Collection of the National Institute of Agricultural Science and Technology, Rural Development Administration, the College of Agriculture and Life Science, Seoul National University, and the Center for Insect Systematics, Kangwon National University. North Korean specimens, which were collected by the expedition of Hungarian Natural History Museum in 1971, were borrowed from Dr. Masao Ito, Hokkaido University, Japan. To provide a identification key, some Japanese and Russian specimens were also examined instead of Korean specimens.

Abbreviations used for the description and collection data: NIAST (National Institute of Agricultural Science and Technology, Korea; SNU (College of Agriculture and Life Science, Seoul National University; CIS (Center for Insect Systematics, Kangwon National University); ITOC (M. Ito's collection); GG (Gyeonggi-do); GW (Gangwon-do); CB (Chungcheongbuk-do); CN (Chungcheongnam-do); JB (Jeollabuk-do); JN (Jeollanam-do); GB (Gyongsangbuk-do); GN (Gyongsangnam-do); RFE (Russian Far East); UL (unknown location); L:W (length: width); T1. . . T7 (abdominal tergite 1. . . 7); Q (queen); W (worker); M (male). Complete specimens label data is available from the authors.

SYSTEMATICS

Genus *Bombus* Latreille, 1802

Key to the subgenera of genus *Bombus* in Korea

1. Meso-basitarsus and metabasitarsus pointed sharply at distoposterior end. Malar space longer than the width at mandibular articulation. Clypeus more or less elongate, as long as wide at the mandibular articulation, hairs only on the basal or along the frons-clypeal suture, the basal suture clearly visible 2
- Meso-basitarsus and metabasitarsus obtuse at distoposterior end, more or less rounded. Malar space shorter than the width at mandibular articulation. Clypeus wider than long, covered with abundant hairs near the base and along the frons-clypeal suture in female completely covered with hairs in male, the basal suture hard to find 5
2. Malar space at least twice as long as antennal segment III. Outer surface of hind tibia polished without hairs except at the very base in male 3

- Malar space less than twice as long as antennal segment III 4
- 3. Clypeus without or with a few weak punctures medially, strong punctures laterally only along the suture. Malar space about twice as long as the width of the mandibular articulation *Megabombus*
- Clypeus completely covered with dense and fine punctures. Malar space less than twice as long as the width of the mandibular articulation *Diversabombus (ussurensis)*
- 4. Outer surface of hind tibia strongly reticulated. Abdominal terga with very close and coarse punctures except tergum 6 which has a coarse, granular surface *Triconibombus*
- Outer surface of hind tibia polished, without reticulation, or weakly reticulated laterally. Abdominal terga without close and coarse punctures in both sexes. Outer surface of hind tibia covered with abundant hairs in male *Thoracobombus*
- 5. Abdominal tergum 6 with a convex, more or less rounded protuberance. Outer surface of hind tibia strongly reticulated *Melanobombus (sichelii sichelii)*
- Abdominal tergum 6 flat with out protuberance. Outer surface of hind tibia polished, not reticulated except for weak reticulation laterally 6
- 6. Malar space as long as wide and quadrate, or if distinctly transverse, then inner margin of eye without fine punctures. Clypeus with sparse weak punctures covered with long, plumose hairs laterally and basally *Pyrobombus*
- Malar space distinctly transverse. Inner margin of eyes with distinct and close punctures. Clypeus with close, strong punctures medially, covered with abundant, long and short plumose hair except in median area *Bombus s. str.*

Subgenus *Megabombus* Dalla Torre, 1890

Malar space at least 1.5 times longer than width at the mandibular articulation. Clypeus as long as width without or with a few strong punctures medially. Each caste with similar hair coloration except on frons. Median part of malar area polished without punctures. Distoposterior angle of meso- and metabasitarsite projected sharply into a strong spur. Outer surface of hind tibia polished, without or very weak reticulation, visible at high magnification only.

Key to the Korean species of subgenus *Megabombus*

- 1. Hairs on ventral side of thorax and abdomen, and on legs mainly black or dark brown 2
- Hairs on ventral side of thorax and abdomen, and on legs (including coxa, trochanter, femur) whitish grey or yellow *B. (M.) consobrinus wittenburgi*
- 2. Thorax and abdominal terga 1-2 yellow or orange. Abdominal sterna 2-5 black *B. (M.) czerskii*
- Thorax and abdominal terga 1-2 black. Abdominal sterna 2-5 whitish yellow *B. (M.) koreanus*

***Bombus (Megabombus) consobrinus wittenburgi* (Vogt) 황토색뒤영벌**
(Figs 2a-c)

Bombus (Hortobombus) consobrinus var. *wittenburgi* Vogt, 1911: 56.

Bombus (Megabombus) consobrinus wittenburgi: Ito, 1985: 9 (First record in Korea).

Specimens examined. NIAST: GG- 1Q, Suwon, 4. IV. 1995 (on *Buxus micorphylla* S. et Z.). GW- 1W, Gesseiji (Weoljungsa, Mt. Odae), 15. IX. 1923; 2W, Mt. Odae, 8. VI. 1994; 5W, 1M, ditto, 12. VII. 1995 (on *Ligustrum obtusifolium* S. et Z.); 5W, Pyeongchang, 11. IX. 1993; 1W, ditto, 12. VII. 1995. North Korea- 1W, Choanji (Jangansa, Mt. Kumgang), 3. VIII. 1924; 1W, Yutenji (Yujeomsa, Mt. Kumgang), 21. VII. 1924. SNU: GG- 1W, Anyang, 5. V. 1992; 1M, Hwasung, 24. VI. 1992; 2W, Mt. Myeongji, 7. VI. 1992; 4W, 1M, ditto, 20-25. VI. 1992; 1W, ditto, 17. V. 1992; 1W, Mt. Yongmun, 11. IV. 1992; 1M, Youngin, 17. IX. 1994. GW- 1M, Bongpyeong, 20. VIII. 1997; 1W, Mt. Heungjung, 5. VIII. 1993; 1W, Mt. Seolag, 25. VIII. 1961. JN- 1M, Nogodan, Mt. Jiri, 25. VII. 1993. CIS: GG- 1W, Mt. Myeongji, 20. VI. 1981. GW- 1Q, Gojindong, 11. V. 1994; 1W, Sogeumgang, Mt. Odae, 30. VI. 1980; 1W, Chuncheon, 7. VI. 1981; 1W, Changchon, Hongcheon, 6. VI. 1992; 1W, Mt. Kwangdeok-san, 25. VI. 1994.

Host flowers. *Buxus micorphylla* S. et Z. and *Ligustrum obtusifolium* S. et Z.

Distribution. Korea (South and North), Northern Europe, Russia (Ural mountains, Siberia, RFE), Japan (Mountains in Honshu), and China (Manchuria, S. Ganshu).

Remarks. This species is easily distinguished from other species in the subgenus *Megabombus* by pale yellow, or pale brown hairs.

***Bombus (Megabombus) koreanus* (Skorikov) 참호박뒤영벌**
(Figs 2d-f)

Hortobombus koreanus Skorikov, 1933: 59 (First record in Korea).

Bombus (Megabombus) koreanus: Sakagami, 1975: 297.

Specimens examined. NIAST: GG- 1W, Gwangleung, 7. VIII. 1920; 1Q, ditto, 14. VI. 1924; 1W, ditto, 20. VI. 1982; 1W, Mt. Suri, 3. VI. 1973; 1W, Yongin, 9. VI. 1981. GW- 1W, Gesseiji (Weoljungsa, Mt. Odae), 8. VII. 1923; CB- 1W, Dandongri, Chungpungmyeon, Jecheon, 31. VII. 1998 (on *Sesamum indicum* Linne); 1W, ditto, 31. VII. 1998 (on *Curcubita moschata* Duche). JB- 1W, Gwancheonri, Sunchang, 12. VIII. 1998 (on *Hisbiscus multabilis* L.). SNU: GG- 1W, Anyang, ?. V. 1970; 1W, ditto, 6. VI. 1987; 1Q, ditto, 9. V. 1987; 1Q, ditto, 26. VII. 1991; 2W, ditto, 27. VI. 1991; 1Q, Anseong, 14. V. 1988; 1W, Mt. Bonam, 6. VI. 1992; 1Q, Mt. Gwanag, 24. VI. 1973; 1W, ditto, 23. VI. ?; 2Q, Gwangju, 20. IV. 1991; 1W, ditto, 23. VI. 1992; 1W, Gwangleung, 2. VII. 1957; 2W, ditto, 10. VI. 1973; 2W, ditto, 22-23. VI. 1992; 1W, Monabsa, 6. VI. 1992; 4W, Mt. Myeongji, 22-21. VI. 1992; 1W, Osan, 4. VI. 1989; 3W, Pocheon, 10. VI. 1988; 1Q, Sanjeonghosu, 2. IV. 1989; 1W, ditto, 4. VI. 1989; 1W, Singal, 22. VI. 1992; 1W, Mt. Soyo, 24. VI. 1986; 1W, ditto, 6. VI. 1988;

1Q, Suwon, 20. IV. 1970; 1W, ditto, 23. V. 1988; 3W, ditto, 3-28. VI. 1988; 2Q, 1W, ditto, 22. VI. 1992; 1Q, ditto, 8. V. 1993; 1W, ditto, 23. VI. 1987; 2W, Yangpyeong, 26. VI. 1986; 2W, ditto, 19-22. VI. 1992; 1Q, Yangji, 14. V. 1970; 1W, Yangsuri, 11. VI. 1986. GW- 1Q, 1W, Mt. Chiak, 10-11. VI. 1998. CB- 1Q, Cheongju, 3. VII. 1983; 1W, Mt. Weolak, 20. VI. 1984. JN- 1Q, 8W, Mt. Jiri, 9-14. VII. 1969; 2Q, 2W, ditto, 22-28. VII. 1973; 1W, ditto, 24. VI. 1993; 1Q, Paegunsa, Mt. Baegun, 24. VII. 1991. CIS- GG- 1Q, Mt. Myeonggi, 23. V. 1991. GW- 1W, Chuncheon, ?. VI. 1980; 1W, ditto, 10. VI. 1980; 1Q, ditto, 21. IV. 1981; 1W, ditto, 20. VII. 1981; 1W, ditto, 5. VI. 1982; 1W, ditto, 10. VI. 1983; 1W, ditto, 16. VII. 1983; 2W, ditto, 15-16. VI. 1984; 1W, ditto, 3. VI. 1986; 2W, ditto, 17-21. VI. 1989; 1W, ditto, 21. IV. 1991; 4Q, 2W, ditto, 10-24. V. 1991; 2W, 1Q, ditto, 1-12. VI. 1991; 1W, 4M, ditto, 10-31. V. 1992; 1W, 1M, ditto, 3-5. VI. 1992; 2W, ditto, 25. VI. 1994; 1Q, ditto, 18. V. 1994; 1Q, ditto, 5. VI. 1995; 2W, ditto, 2-7. V. 1996; 1W, Hongcheon, 22. VI. 1984; 1Q, ditto, 3. VI. 1989; 1W, ditto, 13. VII. 1985; 1W, 1M, ditto, 12. VI. 1992; 1W, ditto, 30. V. 1992; 6W, Geumdaeri, Weonsung, 30. V. 1982. 1W; Youngweol, 5. VII. 1980. CN- 1Q, Buyeo, 18. V. 1991.

Host flowers. *Sesamum indicum* Linne, *Curcubita moschata* Duche, *Hibiscus multabilis* L.

Distribution. Korea (Central and South including Chejudo and Ullungdo)

Remarks. This species is easily distinguished from other species of the subgenus *Megabombus* in Korea by the black hairs covering the whole thorax.

Bombus (*Megabombus*) *czerskii* Skorikov 노서아뒤영벌

Bombus czerskii Skorikov, 1909: 413.

Hortobombus czerskii: Skorikov, 1933: 53-65 (First record in Korea).

Bombus (*Megabombus*) *czerskii*: Ito, 1985: 10.

Specimen examined. ITOC: North Korea- 1Q, Enjomen, Mozangun, Kankyoboku, 27. VII. 1939.

Distribution. N. Korea, Russia (Ussuri), and China (NE).

Remark. The species has not been collected in South Korea. The specimens borrowed from Dr. M. Ito, appears to be closely related to *B. (M.) koreanus*. It can be easily distinguished from the latter by the thorax which is covered with yellow hairs except for a black band across the wing base, and by terga 1 and 2 pale which have brown or yellowish brown hairs basally. The species has not been collected in South Korea.

Subgenus *Diversobombus* Skorikov, 1913

Clypeus as long as wide, covered with dense punctures. Basal part of clypeus with sparse hairs, thus, basal suture conspicuous, similar to the subgenus *Megabombus*. Malar space at least 1.5 times as long as wide and at least twice as long as antennal segment 3. Distoposterior angle of meso- and metabasitarsite sharply pointed, forming a strong spur. Outer surface of hind tibia polished without or with very weak reticulation medially. Abdominal terga 3-5 with black hairs on basally two-third and pale

brown (almost white) hairs on apical third. Antennal segment 3 twice as long as antennal segment 4 in female.

***Bombus (Diversobombus) ussuriensis* Radoszkowski 우수리뒤영벌**
(Figs 2g-i)

Bombus ussurensis Radoszkowski, 1877: 196.

Diverobombus ussuriensis: Shorikov, 1933: 53-65 (First record in Korea).

Bombus (Diversobombus) ussurensis: Sakagami, 1975: 299.

Specimens examined. NIAST: GG- 1Q, Koryo (=Gwangleung), ?. 192?; 2Q, ditto, 20. VI. 1934; 1W, Suwon, 8. IX. 1975; 2Q, ditto, 21. V. 1987; 2Q, ditto, 20. VI. 1988; 2W, ditto, 25. VII. 1994; 2W, ditto, 11. VIII. 1995; 1W, Mt. Taehwa, Gwangju, 19. VIII. 1998 (on *Hibiscus syriacus* L.); 1Q, Yangji, 14. V. 1970; 2M, Mt. Ungil, Yangpyong, 19. X. 1995. GW- 7Q, Daekwanryeong 25. VI. 1988; 5M, ditto, 7. IX. 1993; 1W, Mt. Odae, 14. X. 1995; 2W, 1M, Gesseiji (Weoljunga, Mt. Odae), 15. IX. 1923; 2W, Pyeongchang, 11. IX. 1993; 2W, 1M, Yongpyong, 14. X. 1995 (on *Trifolium pratense* L.). CB- 3W, Chungpungmyeon, Jecheon, 31. VII. 1998 (on *Sesamum indicum* Linne, *Curcubita moschata* Duche). CN- 1Q, Mt. Chilgab, 12. V. 1987; 1W, 2M, Mt. Gyeryong, 20. IX. 1981; 1W, ditto, 11. VII. 1995. JN- 2W, Gwangcheonri, Sunchang, 12. VIII. 1998 (on *Curcubita moschata* Duche); 1W, 1M, Mt. Jiri, 22-28. VII. 1973; 1Q, ditto, 29. V. 1994; 26W, ditto, 30-31. VIII. 1995 (on *Impatiens textori* Miguel); 2W, ditto, 25. X. 1995. GB- 9W, Mt. Sudo, 1. IX. 1995. GN-1W, Namhae, 12. VIII. 1995. North Korea- 1W, Choanji (Jangansa, Mt. Geumgang), 3. VIII. 1924; 1Q, Sharei (Charyeong), VII. 9. 1923; 1Q, Sotokongo (Oe-keumkang, Mt. Kumgang), 9. VII. 1923. SNU: GG- 2W, Anseong, 18. II. ?; 1W, Anyang, 23. VI. 1992; 1W, ditto, 27. IX. 1997; 1W, Mt. Bughan, 26. VI. 1988; 1Q, Mt. Cheonggye, 14. VI. 1981; 2Q, 1W, Cheongpyeong, 6-23. VI. 1987; 1Q, ditto, 6. VI. 1989; 2W, Gwacheon, 22-24. VIII. 1994; 1W, Mt. Gwanag, 3. X. 1994; 2W, Gwangju, 9. V. 1992; 1W, Gwangleung, 13. X. 1968; 1Q, ditto, 18. V. 1981; 1W, ditto, 4. VI. 1986; 1W, ditto, 27. VI. 1989; 1Q, ditto, 29. V. 1990; 1Q, ditto, 18. V. 1991; 1W, ditto, 22. VI. 1992; 3W, ditto, 10-11. IX. 1993; 1Q, ditto, 21. V. 1994; 1M, Kapyong, 12. IX. 1993; 1M, Kanghwado, 25. IX. 1993. 2Q, Mirinae, 14. V. 1988; 1Q, Yeosu, 10. IV. 1990; 3W, Mt. Myoungji, 17-21. VI. 1992; 1W, Pocheon, 10. VI. 1988; 1W, Sanjeonghosu, 2. VI. 1989; 2W, Singal, 18-24. VI. 1992; 3W, Mt. Soyo, 24. VI. 1986; 1W, Mt. Suri, 8. IX. 1968; 1W, ditto, 19. V. 1983; 1Q, Suwon, 7. V. 1970; 1Q, ditto, 6. VI. 1970; 1Q, ditto, 28. V. 1973; 1W, ditto, 9. VIII. 1975; 2W, ditto, 8. IX. 1975; 1Q, ditto, 28. IV. 1984; 1Q, 1W, ditto, 10-30. V. 1986; 1Q, ditto, 5. VI. 1986; 2Q, ditto, 27-30. V. 1987; 1Q, ditto, 22. VI. 1987; 1W, ditto, 2. VII. 1987; 1Q, 4W, ditto, 9-27. VI. 1988; 1Q, ditto, 29. IV. 1989; 3Q, ditto, 2-11. VI. 1990; 1W, ditto, 27. IV. 1991; 1W, ditto, 19. IV. 1992; 1W, ditto, 23-25. VI. 1992; 3W, ditto, 9-13. IX. 1993; 1Q, 9W, 1M, ditto, 24. IX. 1994; 1W, ditto, 21. VII. 1997; 1W, Yongin, 17. IX. 1994. GW- 3W, Bongpyeong, 20. VIII. 1997; 1W, Chuncheon, 12. VIII. 1995; 1Q, Mt. Odae (Sangweonsa), 21. VII. 1974; 2W, ditto, 10. V. 1997; 1W, Pocheon, 10. VI. 1988; 2W, Mt. Seolag, 21-25. VIII. 1961; 1W, ditto, 30. IX. 1983. CB- 1W, Cheongju, 3. VII. 1983; 3W, Eumseong, 9. III.

1993; 2Q, Mt. Sogri, 24. VII. 1960; 1Q, ditto, 6. V. 1979; 3Q, 2W, Mt. Weolag, 20–22. VI. 1984. JN– 1W, Mt. Baekun, 24. VIII. 1995; 1Q, 6W, ditto, 22. VI. 1988; 1W, Mt. Jiri, 9. VI. 1969; 2W, ditto, 9–10. VII. 1969; 1W, ditto, 14. VIII. 1970; 1W, ditto, 24. VII. 1971; 1Q, 56W, ditto, 22–27. VII. 1973; 6W, 2M, ditto, 15–17. VII. 1976; 3W, ditto, 10. VIII. 1978; 1W, ditto, 26. IV. 1986; 1M, ditto, 25. VI. 1986; 1Q, ditto, 15. V. 1990; 4W, ditto, 24–26. VI. 1993; 1W, ditto, 14. VI. 1997; 2W, Kwangyang, 19–20. VIII. 1994. 1W, Mogpo, 22. VI. 1986; 1W, Mt. Mudeung, 24. VI. 1988; 1M, Suncheon, 12. IX. 1993. GB– 1Q, Cheongsong 2. V. 1994. CIS: GG– 1Q, Kapyeong, 5. VI. 1994. GW– 1Q, Baegyangri, 11. V. 1986; 1Q, Mt. Chiak, 22. V. 1991; 1W, Chuncheon, 22. VI. 1984; 1M, ditto, 12. X. 1984; 1Q, 1W, ditto, 28–30. V. 1990; 1Q, ditto, 5. IX. 1990; 1Q, ditto, 22. V. 1991; 2M, 1W, ditto, 2–22. VI. 1992; 3W, ditto, 6–30. V. 1992; 1Q, ditto, 8. VI. 1993; 1Q, 1W, ditto, 4–5. VI. 1995; 1Q, ditto, 10. VI. 1996; 1Q, Mt. Jeombong, 20. VI. 1992.

Distribution. Korea (North, Central), China (Northeast), Russia (Ussuri), and Japan (Honshu).

Host flowers. *Trifolium pratense* L., *Impatiens textori* Miguel, *Hibiscus syriacus* L., *Sesamum indicum* Linne, *Curcubita moschata* Duche.

Remarks. Two species of subgenus *Diversobombus*, *B. ussurensis* and *B. diversus*, have been recorded in Korea. The geographical study of Sagakami (1975), however, shows that *Bombus diversus* is distributed in Japan and Sakhalin, exclusively. No *B. diversus* specimen has also been found in this study.

Subgenus *Thoracobombus* Dalla Torre, 1880

Antennal segment 3 twice as long as antennal segment 4 in female. Clypeus nearly as long as wide with many weak punctures medially. Basal part of clypeus with sparse hairs, thus basal suture conspicuous. Malar space as long as wide or a little longer than wide and twice as long as antennal segment 3. Distoposterior angle of meso- and metabasite sharply pointed. Outer surface of hind tibia polished, not reticulated, covered with many hairs all over in male.

Key to the species of subgenus *Thoracobombus* in Korea

1. Hairs on ventral side of thorax and on abdomen including frons and legs completely black or dark brown *B. (Th.) opulentus*
- Hairs on ventral side of thorax and on abdomen white or pale yellow mixed with few black hairs 2
2. Thorax with at least dark brown or black hairs dorso-medially 3
- Thorax entirely covered with orange or pale yellow hairs 5
3. Thorax with dark hairs except for a narrow pale band of hairs on collar and scutellum. Abdominal terga with distinct black and white hair band as *B. ussurensis* *B. (Th.) pseudobaicalensis*
- Thorax pale yellow, except for a band of dark hair bands across the wing base. Abdominal terga pale 4
4. Hairs of head, thorax and abdomen entirely pale yellow except for narrow band of dark hairs across the wing base *B. (Th.) humilis subbaicalensis*
- Thorax with broad band of dark hairs across the wing base. T1 with dark hairs apically

- *B. (Th.) anchoreta*
5. Corbicular fringe largely white, frons with mainly white hairs, T2-5 with a distinct band of black hair basally *B. (Th.) shrenki albidopleuralis*
- Corbicular fringe completely black or dark brown, frons and vertex with long dark brown hairs. T2-5 without distinct band of black hairs; black hairs restricted to lateral area *B. (Th.) pascuorum flavobarbatus*

***Bombus (Thoracobombus) opulentus* Smith 참뒤영벌**
(Figs 2i-k)

Bombus opulentus Smith, 1864: 153.

Bombus koreensis Radoszkowski, 1887: 42 (First record in Korea).

Bombus (Thoracobombus) opulentus: Sakagami, 1975: 295.

Specimens examined. NIAST: GG- 1Q, Anseong, 15. V. 1987; 2W, 3M, Mt. Dobong, 19. X. 1958; 1Q, Gwangleung, 15. V. 1975 (colour variation form); 1W, ditto, ?; 1Q, Kasan (Mt. Hwa, Hwaseong), 17. VI. 1922; 1Q, Mt. Suri, 6. V. 1973; 1W, Suwon, 25. VII. 1958; 2W, ditto, 1. IX. 1968; 2W, ditto, 9-22. IX. 1975; 1Q, ditto, 21. V. 1987; 1Q, ditto, 20. VI. 1988; 1W, ditto, 3. VIII. 1989. GW- 1M, Pyeongchang, 8. IX. 1993. CN- 1W, Hoengseong, 13. VIII. 1998 (on *Lespedeza bicolor* Turczaninow). JN- 2W, Hakuyosan (Mt. Baekyang), 10. IX. 1921; 1W, Jindo, 24. VIII. 1975. GN- 2W, Namhae, 12. VIII. 1995. HN- 1Q, Shakuoji (Seogwangsa, Weonsan), 24. IX. 1925. SNU: GG- 1Q, Anyang, 28. V. 1970; 1Q, Balan, 30. V. 1992; 1Q, Mt. Cheonggye, 20. V. 1973; 1Q, 1W, Joam, 16. VI. 1992; 1W, Gwangleung, 10. VI. 1913; 3Q, Mt. Suri, 6. V. 1973; 2Q, 4W, ditto, 17. VI. 1973; 1Q, Suwon, 29. VI. 1958; 1W, ditto, 28. VIII. 1958; 1Q, ditto, 10. V. 1959; 3Q, ditto, 24. V. 1968; 2Q, ditto, 15-25. VI. 1968; 1W, ditto, 15. IX. 1968; 1W, ditto, 19. XI. 1971; 1W, ditto, 8. IX. 1975; 1Q, ditto, 30. V. 1983; 1W, ditto, 4. V. 1989; 1W, ditto, 20. VI. 1989; 1Q, ditto, 25. V. 1990; 1Q, ditto, 7. VI. 1990; 1Q, ditto, 13. V. 1992; 1Q, ditto, ?; 1W, ditto, 23. VI. 1992; 2W, ditto, 8-19. IX. 1993; 3Q, Yangji, 14-16. V. 1970; 1Q, ditto, 1. VI. 1958. CB- 1W, Cheongju, 25. VI. 1988. JN- 1Q, Mt. Jiri (Hwaomsa), 10. VII. 1969; 1W, ditto, 24. VII. 1971. UL- 1Q, ?; 1W, ?; 1W, Giseungsa, VI. 7. ?. CIS: GG- 1Q, Mt. Myongji, 23. V. 1991. GW- 1W, Chuncheon, 14. VII. 1980; 1W, ditto, 15. VII. 1982; 1M, ditto, 14. X. 1984; 3Q, ditto, 11-29. V. 1991; 1Q, ditto, 31. V. 1992; 1Q, ditto, ? V. 1993.

Distribution. Korea (North, Central and South including Jeju) and China (North, Central).

Host flower. *Lespedeza bicolor* Turczaninow.

Remark. This species can be easily distinguished from other species of the subgenus *Thoracobombus* by the mostly black pubescence of the body, except for the ferruginous hairs of thorax dorsally and of abdominal terga 1-2. A queen specimen collected in Gwangleung has paler pubescence, with bands of pale brown hairs apically on abdominal terga 3-5, however, it is considered as an infraspecific variation.

Bombus (*Thoracobombus*) *schrencki albidopleuralis* Skorikov 슈렌키뒤영벌
(Fig. 2n)

Bombus (*Agrobombus*) *schrencki albidopleuralis* Skorikov, 1914: 406.

Bombus (*Thoracobombus*) *schrencki albidopleuralis*: Sakagami, 1975: 294 (First record in Korea).

Specimens examined. NIAST: GW- 1W, Gesseiji (Weoljeonsa, Mt. Odae). 15. IX. 1923; 1W, Onseiri (Onjeongri, Mt. Geumgang), 25. VII. 1924. ITOC: North Korea- 1M, Sam-zi-yan 1600 m, Plateau Chann-Pay, Prov. Ryang gang, 25. VIII. 1971.

Distribution. Korea (North, Central), Poland, Russia (Siberia, RFE), China (North), Manchuria, and Japan (Hokkaido).

Remarks. This species has similar colour patterns to *Bombus* (*Th.*) *pascuorum flavobarbatus* which is known from North Korea. It can be distinguished by white hairs around the eyes (in *Bombus* (*Th.*) *pascuorum flavobarbatus*, hairs around eyes black and dark brown).

Bombus (*Thoracobombus*) *pascuorum flavobarbatus* Morawitz 진뒤영벌

Bombus flavobarbatus Morawitz, 1883: 242.

Bombus (*Thoracobombus*) *flavobarbatus*: Sakagami, 1975: 295 (First record in Korea).

Bombus (*Thoracobombus*) *pascuorum flavobarbatus*: Ito, 1985: 15.

Specimens examined. ITOC: North Korea- 1W, Mt. Pektusan 1900m, Prov. Ryang gang, 28. VIII. 1971.

Distribution. Korea (North), Europe, Turkey, Iran, North Kazakhstan, Russia (Siberia), and China (North, Central).

Remark. This species was previously recorded from North Korea by Sakagami (1975) and Ito (1985).

Bombus (*Thoracobombus*) *humilis subbaicalensis* Vogt 바이칼뒤영벌

Bombus humilis var. *subbaicalensis* Vogt, 1911: 54.

Bombus (*Thoracobombus*) *humilis sabbaicalensis*: Ito, 1985: 15 (First record in Korea).

Specimen examined. SNU: GG- 1Q, Yangji, 23. VII. 1955.

Distribution. Korea (North, Central), Europe, Crimea, Turkey, Iran, Caucasus, Transcaucasia, South Ural mountains, North Kazakhstan, Ussuri. Mongolia (North), and China (Northeast including Manchuria).

Remarks. This is the first record of this species from S. Korea.

Bombus (*Thoracobombus*) *anachoreta* Skorikov 애뒤영벌

Bombus anachoreta Skorikov, 1914: 407.

Bombus anachoreta: Skorikov, 1933: 53-65 (First record in Korea).

Bombus (Thoracobombus) anachoreta: Kim, 1987: 1-40.

Specimens examined. SNU: GG- 2W, Suwon, 28. VIII. 1958.

Distribution. Korea (Central), Mongolia, Russia (Ussuri), and Northeast China.

Remarks. This species can be easily distinguished from other species of the subgenus *Thoracobombus* by the pale yellow hairs of the thorax, and abdomen except for a narrow band of dark hairs across the wing base and by the small body size. Specimens have been reported only from the central part of the Korean peninsula, except for a doubtful record from Pusan (Skorikov, 1933).

***Bombus (Thoracobombus) pseudobaicalensis* Vogt 담색뒤영벌**

Bombus (Agrobombus) equestris pseudobaicalensis Vogt, 1911:43.

Bombus (Thoracobombus) pseudobaicalensis: Ito, 1985: 17 (First record in Korea).

Specimen examined. No Korean specimen.

Distribution. Korea (Northeast), Russia (Siberia, RFE), Northeast China (Manchuria), and Japan (Hokkaido, Honshu).

Remark. A worker was reported from North Korea (North eastern part) by Ito (1985), but no specimen was found in South Korea.

Subgenus *Tricornibombus* Skrikov, 1922

Clypeus densely punctured. Distoposterior angle of meso- and metabasitarsitae sharply pointed. Outer surface of hind tibia finely reticulated. Abdominal terga with very coarse punctures, except 6th tergum with coarse granules.

Key to the species of subgenus *Tricornibombus* in Korea

1. Hairs on thorax and abdomen orange red dorsally and dark brown or black ventrally as well as on legs.
Punctures on abdominal terga dense and coarse *B. (Tr.) atripes*
- Dorsal and ventral body hairs pale yellow, punctures on abdominal terga distinct, well separated, not as coarse *B. (Tr.) tricornis*

***Bombus (Tricornibombus) atripes* (Smith) 중국세뿔뒤영벌 (신칭)
(Figs 1a-h, 3a-c)**

Bombus atripes Smith, 1852: 44.

Megabombus (Tricornibombus) atripes: Tkalcu, 1968a: 87.

Specimens examined. NIAST: GG- 1Q, Koryo (Gwangleung), 10. IV. 1923.; 1Q. ditto, ?. 1924.;

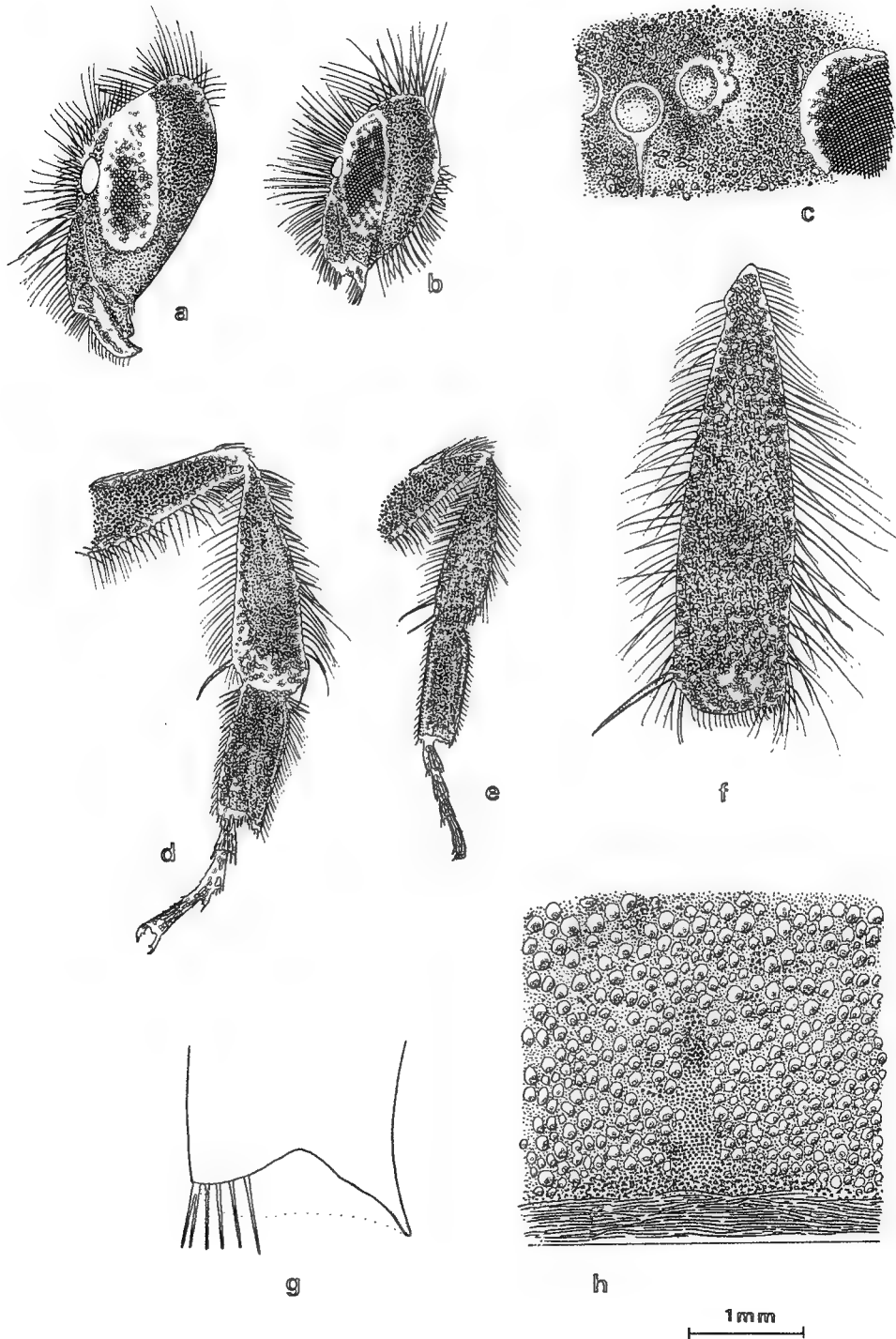


Fig. 1. *Bombus* (*Tricornibombus*) *atripes* (Smith): a-b. Lateral view of head (a. queen, b. male); c. Ocellorbital area; d-e. Hind leg (queen, male); f. Hind tibia (male); g. Apical contour of mid-basitarsus (queen); h. Mediapical surface of metasomal tergum V(queen). Magnification: a-b. 10 ×; c. 30 ×; d-e. 7.5 ×; f. 20 ×; g-h. 49 ×.

1W, 1M, ditto, 22. VIII. 1918; 1W, ditto, 19. VI. 1922; 4M, ditto, 7. VII. 1920. North Korea- 1Q, Shakuoji (Seogwangsa, Weonsan), 5. VI. 1923.

Distribution. Korea (Central) and China (South, Central).

Remark. This species occurs in the southern and central China and is recorded for the first time from Korea. All of the specimens examined were collected in the 1920s and no additional collection has not been collected. The type specimen was not examined. The materials was identified in comparison with the reference specimens collected in China and preserved in the Smithsonian Institution. Keys and the descriptions are based solely on the Korean specimens listed.

***Bombus (Tricornibombus) tricornis* Radoszkowski 세뿔뒤영벌**

Bombus tricornis Radoszkowski, 1888: 319.

Tricornibombus tricornis: Skorikov, 1933: 53-65 (First record in Korea).

Megabombus (Tricornibombus) tricornis: Tkalcu, 1968b: 83.

Bombus (Tricornibombus) tricornis: Sakagami, 1975: 296.

Specimens examined. NIAST: GW- 2Q, Gesseiji (Weoljeongsa, Mt. Odae), 8. VII. 1923; 1Q, ditto, 15. IX. 1923; 1W, no label.

Distribution. Korea (North, Central), Russia (Ussuri), and China (Northeast).

Remarks. This species can be easily distinguished by the well reticulated outer surface of the hind tibia and the dense and strong puncture on abdominal tergum.

Subgenus *Melanobombus* Dalla Torre, 1880

Outer surface of hind tibia well reticulated. Distoposterior angle of meso- and meta- basitarsite more or less rounded, not pointed. Sixth abdominal tergum with a bare, convex, more or less rounded protuberance.

***Bombus (Melanobombus) sicheli sicheli* Radoszkowski 흰목도리뒤영벌**

Bombus sicheli Radoszkowski, 1859: 481.

Bombus (Melanobombus) sicheli sicheli: Sakagami, 1975: 300 (First record in Korea).

Specimens examined. No Korean specimen.

Distribution. Korea (North, Central), Europe (Poland, Mountains in Pyrenees, Alps, Balkan peninsula and Caucasus), Russia (Siberia, RFE), and Northeast China.

Remark. No Korean specimens was examined in this study, instead, a queen from Amur, which is preserved in the Canadian National Insect Collection, was examined for the identification keys.

Subgenus *Pyrobombus* Dalla Torre, 1880

Malar space quadrate, as long as wide. Clypeus slightly wider than long, polished with many small weak punctures or sparse, strong punctures. Distoposterior angle of meso- and meta-basitarsite rounded. Outer surface of hind tibia polished, not or weakly reticulated. Coloration of male, with pale yellow or bright colour, different from female.

Key to the species of subgenus *Pyrobombus*

1. Ventral hairs on thorax and abdomen as well as on legs (coxa, trochanter, femur) black or dark brown 2
 - Entire pubescence whitish or pale yellow *B. (Pyrobombus) modestus*
2. Thorax (dorsally and laterally) and T1-T2 yellow, T3-T4 (basal half) black, T4 (apical half) and T5 white *B. (Pyrobombus) hypnorum calidus*
 - Body covered with black hairs except T4-5. T2 sometimes with whitish hairs basally *B. (Pyrobombus) ardens ardens*

Bombus (Pyrobombus) ardens ardens Smith 좀뒤영벌
(Figs 3d-f)

Bombus ardens Smith, 1879: 133.

Bombus ardens: Doi, 1938: 35-40 (First record in Korea).

Bombus (Pyrobombus) ardens: Sakagami et Ishikawa, 1969: 186.

Specimens examined. NIAST: GG- 1W, Mt. Gwanag, 25. V. 1985; 1W, Gwangleung, 6. X. 1973; 1W, Suwon, 16. IX. 1984; 1Q, 2W, ditto, 21-26. IV. 1989 (on *Malus pumila* Miller and *Prunus persica* L.); 2Q, ditto, 2. V. 1989; 3W, ditto, 22. VI. 1989 (on *Althaea rosea* Cananil); 2W, ditto, 24-30. IV. 1990 (on *Prunus persica* L. and *Malus pumila* Miller); 2Q, 2W, ditto, 16-24. IV. 1994 (on *Weigela subsessilis* (Nakai)); 2Q, ditto, 16. VI. 1994; 1M, ditto, 25. VII. 1994; 1W, ditto, 2. V. 1995; 2M, ditto, 18. VI. 1995; 1M, ditto, 18. IV. 1996; 1Q, ditto, 14. IV. 1997; 1Q, ditto, 30. VI. 1997; 2Q, ditto, 22-24. IV. 1998 (on *Rhododendron schlippenbachii* Maximowicz and *Weigela subsessilis* (Nakai)). GW- 2Q, 1M, Mt. Odae, 12. VII. 1995 (on *Ligustrum obtusifolium* S. et Z.); 1W, Hangyeryong, 10. VI. 1994; 1W, 2M, Mt. Seolak, 9. VI. 1994. CB- 2Q, Asan, 18. VIII. 1993. CN- 2W, Mt. Chilgab, 12. V. 1987. JN- 1W, Mt. Jiri, 13. VIII. 1979; 1W, ditto, 30. VIII. 1995 (on *Lespedeza bicolor* Turczaninow). SNU: GG- 2W, Mt. Acha, 9. VII. 1993; 1W, ditto, 3. VI. 1990; 2M, Anjung, 7. VI. 1992; 1M, ditto, 6. VII. 1992; 2W, Anseong, 14. V. 1988; 3W, Anyang, 25. V. 1985; 2W, ditto, 25. V. 1986; 1Q, 5W, ditto, 22-30. V. 1987; 4W, ditto, 6-23. VI. 1987; 1W, ditto, 21. V. 1988; 1W, ditto, 6. VI. 1988; 9W, 1M, ditto, 24-29. VI. 1989; 6W, ditto, 8-23. V. 1990; 3W, ditto, 2. VI. 1990; 1M, ditto, 27. VI. 1991; 4W, ditto, 5-24. V. 1992; 5M, ditto, 23-24. VI. 1992; 1W, ditto, 13. V. 1993; 4W, 1M, Balan, 2-16. VI. 1992; 1W, Mt. Cheonggye, 30. V. 1986; 1W, ditto, 30.

V. 1992; 2W, Cheongpyeong, 10. VI. 1987; 1M, Mt. Daemo, 12. VI. 1988; 1M, Dangsur, 11. VI. 1986; 1Q, Gapyeong, 12. V. 1991; 1W, Mt. Gwanag, 30. V. 1937; 1W, 7M, ditto, 12-29. VI. 1973; 1W, ditto, 30. V. 1987; 1W, ditto, 31. V. 1988; 1W, 1M, ditto, 22. VI. 1992; 1W, ditto, 23. X. 1993; 1W, ditto, 7. VIII. 1994; 1W, Incheon, 4. V. 1982; 2M, ditto, 5. IV. 1990; 1M, ditto, 24. V. 1992; 3W, 4M, Mt. Myeongji, 5-21. IV. 1992; 3W, ditto, 14. V. 1992; 1W, 2M, ditto, 7-14. VI. 1992; 1M, Gwangju, 26. VI. 1989; 2Q, 7W, ditto, 9-12. V. 1992; 1Q, ditto, 19. IV. 1994; 1W, Gwangleung, 17. V. 1992; 4M, ditto, 22. VI. 1992; 1W, 3M, Hwaseong, 6-22. VI. 1992; 1W, Namhansanseong, 5. VI. 1988; 1W, Ocheon, 23. I. 1988; 1W, Pyeongtaeg, 27. V. 1992; 1M, Seoul, 5. VI. 1969; 1M, ditto, 22. VI. 1988; 5W, ditto, 13. V. 1990; 2W, 1M, ditto, 3-10. VI. 1990; 1M, ditto, 14. VI. 1992; 1W, ditto, 16. VII. 1993; 3W, 6M, Singal, 12-22. VI. 1992; 1M, Mt. Suri, 6-18. VI. 1973; 1Q, 1W, Songdo, 6. VI. 1991; 1W, Mt. Sorae, 5. VIII. 1984; 1W, Suwon, 21. VI. 1959; 1M, ditto, 9. VI. 1973; 1W, ditto, 30. V. 1980; 2W, ditto, 13-30. V. 1983; 1Q, 1W, ditto, 8. V. 1984; 2Q, 1W, Suwon, 1-6. VI. 1985; 1W, ditto, 3. VI. 1986; 10W, ditto, 6-30. V. 1986; 1W, 2M, ditto, 16-27. V. 1987; 9W, 1M, ditto, 6-30. VI. 1987; 1M, ditto, 2. VII. 1987; 3W, 2M, ditto, 9-27. VI. 1988; 1W, ditto, 27. V. 1988; 1Q, ditto, 27. IV. 1989; 5W, ditto, 17-27. V. 1989; 1Q, 7W, 6M, ditto, 17-25. VI. 1989; 1Q, 1W, ditto, 19. IV. 1990; 25W, 2M, ditto, 3-29. V. 1990; 28W, 2M, ditto, 1-18. VI. 1990; 1Q, ditto, 25. IV. 1991; 1W, 2M, ?, 2-27. V. 1991; 1Q, 4W, 1M, ditto, 18. VI. 1991; 1W, ditto, 1. III. 1992; 6W, 6M, ditto, 5-30. V. 1992; 2Q, 22W, 25M, ditto, 1-25. VI. 1992; 1Q, ditto, 8. V. 1993; 3W, ditto, 9. VI. 1995; 1W, ditto, 25. V. 1996; 1W, ditto, 2. VI. 1997; 3M, Yangpyeong, 19-22. VI. 1992; 1W, Yeosu, 10. IV. 1990; 1Q, Mt. Yongmun, 10. IX. 1990. GW- 2W, Mt. Chiag, 21. VI. 1988; 1W, Gangneung, 30. V. 1986; 1W, ditto, 4. VI. 1988; 1M, Taebaeg, 25. VI. 1995. CB- 3W, 2M, Cheongju, 10-22. VI. 1992; 1W, Goesan, 23. 1VI. 992; 2M, Cheongweon, 22. VI. 1992; 1Q, Mt. Weolag, 19. V. 1990; 1W, ditto, 19. VI. 1990; 1Q, ditto, 20. VI. 1991; 2W, 3M, ditto, 12-22. VI. 1992. CN- 1W, Sindon, 27. VIII. 1993. GB-2W, Andong, 1. V. 1994; 1W, Cheongsong, 2. V. 1994; 1M, Gyeongju, 23. VIII. 1995; 1Q, Mt. Sobaeg, 15. VII. 1994. JB- 1M, Jeonju. 10. VI. 1990. JN- 1M, Mt. Baegun, 23. VI. 1986; 1Q, 4M, ditto, 22. VI. 1988; 1W, ditto, 23. VI. 1992; 7W, 10M, ditto, 23-24. VI. 1995; 1M, Mt. Jiri, 10. VII. 1969; 1W, ditto, 16. VII. 1976; 1W, ditto, 10. VIII. 1978; 1W, ditto, 15. VII. 1988; 1W, ditto, 13. VI. 1990; 1Q, ditto, 21. VII. 1991; 2W, 4M, ditto, 24-26. VI. 1993. GN- 2W, Busan, 25. VI. 1997; 1M, Eonyang, 24. V. 1992; 1W, Taejongdae, 26. VI. 1991. JJ- 1Q, Jeju, 3. V. 1992; 1W, Seongsan, 12. IV. 1992. CIS: GG- 1Q, Mt. Myongji, 23. V. 1991. GW- 1W, Chuncheon, 14. VII. 1980; 1W, ditto, 15. VII. 1982; 1M, ditto, 14. X. 1984; 3Q, ditto, 11-29. V. 1991; 2Q, ditto, ?-31. V. 1992.

Distribution. Korea (South) and Japan.

Host flowers. *Prunus persica* L., *Malus pumila* Miller, *Althaea rosea* Cananil, *Lespedeza bicolor* Turczaninow, *Ligustrum obtusifolium* S. et Z., *Wiegela subsessilis* (Nakai), *Rhododendron schlippenbachii* Maximowicz.

Remarks. This species is one of the most common in Korea and is frequently found on plants in open areas around villages and in agricultural fields at low elevation. It can be easily distinguished from other species of the subgenus *Pyrobombus* by its predominantly black pubescence except T4-6 which have orange hairs.

Bombus (Pyrobombus) modestus Eversmann 회색뒤영벌
(Figs 3g-i)

Bombus modestus Eversmann, 1852: 134.

Bombus (Pyrobombus) modestus: Tkalcu, 1968: 21-51.

Bombus (Pyrobombus) modestus: Sakagami, 1975: 302 (First record in Korea).

Specimens examined. NIAST: GW- 1W, Hwoengseong (Yongdong Tunnel), 15. VIII. 1995 (on *Spiraea salicifolia* L.); 4W, 1M, Mt. Odae, 12-14. VII. 1995 (on *Ligustrum obtusifolium* S. et Z.); 1W, Pyoungchang, 11. IX. 1993; 5W, Mt. Taebaek, 15. VIII. 1989. JN- 1W, Nogodan, Mt. Jiri, 25-27. VII. 1973. SNU: GG- 2W, Mt. Dobong, 23. VI. 1992. ; 1W, Mt. Heungjung, 26. VII. 1993. GW- 1W, Bongpyong, 20. VIII. 1997; 1W, Mt. Seolak, 18. VII. 1995. JN- 1W, Mt. Baekun, 22. VI. 1988; 1W, Mt. Jiri (Hwa-eomsa), 10. VII. 1969; 6W, ditto (Nogodan), 25-27. VII. 1973; 1W, ditto, ?. VII. 1995. CIS: GG- 1W, Mt. Yaksu, 9. VIII. 1989. GW- Mt. Obong (Chuncheon), 22. VI. 1984.

Distribution. Korea (North, South) and Russia (Siberia, RFE).

Host flowers. *Spiraea salicifolia* L., *Ligustrum obtusifolium* S. et Z.

Remark. All specimens of this species have been collected from mountainous regions.

Bombus (Pyrobombus) hypnorum calidus Erichson 붉은뒤영벌

Bombus calidus Erichson, 1851: 65.

Bombus (Pyrobombus) hypnorum calidus: Sakagami, 1975: 300 (First record in Korea).

Specimen examined. No Korean specimen.

Distribution. Korea (North), Russia (Siberia, RFE), Europe (Fennoscandia to Spain), and Japan (Hokkaido)

Remark. No specimen has been collected after Sakagami, 1975.

Subgenus *Bombus* s. str. Latreille, 1802

Clypeus shape as a half circle, wider than long and polished, covered with many strong punctures, dense hairs basally. Malar area transverse, wider than long. The distoposterior angle of meso- and metabasitarsite more or less rounded (not pointed). Outer surface of hind tibia polished, not reticulated medially.

Key to the species of subgenus *Bombus* s. str.

1. Hairs on thorax black and well trimmed *B. (Bombus) ignitus*
- Hairs on thorax normal, colour variable, at least collar with bright coloured hairs (yellow, orange or pale yellow) 2

2. Collar and scutellum with board band of pale coloured hairs (white or pale orange), T1 with white or pale yellow hairs 3
 - Pronotum with black hairs, except collar with narrow band of pale yellow hairs, sometimes (worker) scutellum with narrow band of pale yellow hairs. T1 with black (queen) or yellow hairs (worker)
 *B. (Bombus) hypocrita*
3. Thorax and abdomen as well as part of femur with white hairs. Hairs on frons and clypeus mainly whitish yellow with admixture of dark hairs. Broad dark hair band across the wing base, usually broader than the white hair band of collar. Collar, scutellum, T1, T4-T6 white. T2 orange
 *B. (Bombus) patagiatus patagiatus*
- Ventral hairs of thorax and abdomen black or dark brown. Hairs on frons dark brown. Dark hair band of thorax narrow between wing bases, narrower than the orange band of collar. Collar, scutellum and T1-T2 pale orange *B. (Bombus) sporadicus czerskiadicus*

***Bombus (Bombus) ignitus* Smith 호박벌**

(Figs 3j-l)

Bombus ignitus Smith, 1869: 207.

Bombus lapidarius var. *kalinowski* Radoszkowski, 1887: 430 (First record in Korea).

Bombus (Bombus) ignitus: Sakagami et Ishikawa, 1969: 185.

Specimens examined. NIAST: GG- 1Q, Mt. Cheonma, Yangju, 25. IV. 1976; 1Q, Gwangjeung, VI. 20. 1983; 1W, ditto, ?; 1M, Gwangju (Mt. Taehwa), 19. VIII. 1998 (on *Hibiscus syriacus* L.); 1W, Mt. Suri, 24. VIII. 1986; 1Q, Suigen (Suwon), 14-19. IV. 1922; 1Q, ditto, 10. V. 1922; 2Q, ditto, 10. V. 1923; 1Q, ditto, 16. V. 1924; 1Q, ditto, 25. IV. 1927; 1Q, ditto, 4. V. 1959; 1Q, ditto, 7. V. 1972; 1Q, ditto, 17. V. 1974; 2Q, ditto, 16. V. 1990; 1Q, ditto, 21. IV. 1993; 4W, 2M, ditto, 11-28. VIII. 1995; 1Q, Kasan (Hwasan, Hwaseong), 1. VI. 1922. GW- 1W, Daekwanryong, 16. VI. 1973; 1W, ditto, 25. VI. 1988; 1W, ditto, 7. IX. 1993; 3M, Geseiji (Weoljeongsa, Mt. Odae), ? IX. 1923; 3W, 7M, Pyoungchang, 8-11. IX. 1993; 1M, ditto, 13. X. 1995; 1W, Wonju, 5. VIII. 1989; 8W, Yongdong tunnel, Hwoengseong, 15. VIII. 1995 (on *Spiraea salicifolia* L.). CN- 1W, Cheongweon, 24. VI. 1994; 1W, Koesan, 30. VII. 1998 (on *Spiraea salicifolia* L.); 6W, Chungpungmyeon, Jecheon, 31. VII. 1998 (on *Hibiscus syriacus* L., *Lycium chinense* Miller, *Curcubita moschata* Duche, and *Leonurus sibiricus* L.). JN- 8M, Mt. Jiri, 30. VIII. 1995 (on *Impatiens textori* Miguel). GB- 1W, Chongsong, 9. VIII. 1995 (on *Capsicum annuum* L.); 2W, Kimcheon, 1. IX. 1995 (on *Lespedeza bicolor* Turczaninow); 1W, Mt. Sudo, 1. IX. 1995 (on *Patrinia villosa* (Thunberg)). JJ- 1Q, Saishuto (Chejudo), 6. ? 1919. North Korea- 1W, Onseiri (Onjeongri, Mt. Geumgang), 27. VII. 1924; 2Q, Shakuoji (Seogwangsa, Weonsan); 1W, 1M, Sototongo (Oegeumgang, Mt. Geumgang), 22. VI. 1923, 5. VI. 1923; 1W, Kankakei (Hanhagye, Mt. Geumgang), 27. VII. 1924. UL- 3Q, no lavel. SNU: GG- 1W, Anyang, 25. VI. 1989; 3W, ditto, 21-27. V. 1991; 1W, ditto, 9. VIII. 1991; 1W, ditto, 24. V. 1992; 1W, ditto, 23. VI. 1992; 1M, ditto, 27. IX. 1997; 2M, Balan, 4. IX. 1993; 1Q, Mt. Suri, 6. V. 1973; 1W, ditto, 19. VI. 1976; 1Q, Mt. Gwanag, 27. V. 1973; 1W, ditto, 24. VI. 1973; 1W, ditto, 11. VII. 1994; 1Q, Gwangju, 21.

IV. 1990; 1Q, ditto, 19. V. 1990; 1W, 4M, Gwangleung, 13. X. 1968; 1W, ditto, 6. VI. 1970; 1Q, ditto, 10. VI. 1973; 1Q, ditto, 17. V. 1992; 2M, ditto, 11. IX. 1993; 2Q, 1M, ditto, 21. V. 1994; 1Q, Mt. Cheonggye, 14. VI. 1981; 1W, 3M, Gapyeong, 12. IX. 1993; 1W, Gwacheon, 24. VI. 1988; 4W, ditto, 22. VIII. 1994; 1M, ditto, 17. IX. 1997; 1W, Mt. Myeongji, 20. VI. 1992; 1Q, Namhansanseong, 17. X. 1994; 2W, ditto, 7. IX. 1994; 1W, 1M, Seooreung, Goyang, 1. VIII. ?; 1Q, Seoul, 13. V. 1990; 1W, 1M, ditto, 20. VIII. 1994; 4W, Singal, 12-22. VI. 1992; 1W, Sinseo, Yeoncheon, 1. VII. 1986; 1Q, Suwon, 7. V. 1959; 1W, ditto, 10. VII. 1962; 1Q, ditto, 24. V. 1968; 1Q, ditto, 20. IV. 1972; 1M, ditto, 19. IX. 1973; 2Q, ditto, 1. V. 1977; 1Q, ditto, 14. V. 1983; 1Q, ditto, 27. IV. 1988; 1W, ditto, 3. VI. 1988; 2W, ditto, 24. IV. 1989; 9W, ditto, 17-26. VI. 1989; 3Q, ditto, 20. IV. 1990; 7Q, ditto, 6-26. V. 1990; 1Q, ditto, 3. VI. 1990; 2W, ditto, 12-20. V. 1992; 2W, ditto, 12-25. VI. 1992; 1Q, ditto, 8. V. 1993; 3W, ditto, 9. IX. 1993; 5W, ditto, 23-30. VIII. 1994; 1Q, 2M, 2W, ditto, 14-24. IX. 1994; 1W, ditto, 5. X. 1994; 1W, ditto, 29. VIII. 1995; 2W, ditto, 23. IX. 1995; 1W, ditto, 27. IX. 1997; 1Q, ditto, ? V. ?; 1Q, Mt. Yongmun, 11. IV. 1992; 2Q, ditto, 5. V. 1990; 1Q, Yangpyeong, 19. VI. 1992; 1W, Yongin, 16. VII. 1994; 1W, 1M, ditto, 7-17. IX. 1994. GW- 3W, Bongpyeong, 20. VIII. 1997; 1W, 1M, Mt. Chiag, 20. VIII. 1994; 2W, Cheongpyeongsa, Chuncheon, 30. VII. 1994; 1W, Mt. Heungjung, 5. VIII. 1993; 1M, Oak Valley, Wonju, 12. IX. 1997; 2W, Mt. Seolag, 7. VIII. 1958; 1W, ditto, 18. VII. 1995. CB- 8W, 1M, Eumseong, 8-9. III. 1993; 1Q, 1M, Mt. Weolag, 30. IX. 1983; 2Q, ditto, 19. V. 1990; 1Q, ditto, 24. VII. 1990. CN- 1W, Mt. Sogri, 28. VI. 1989. GB- 1Q, Cheongsong, 27. IV. 1994; 1M, Gyeongju, 23. VIII. 1995. JN- 1W, Mt. Baegun, 12. VIII. 1994; 2W, ditto, 23-24. VI. 1995; 1W, Jucheon, Namweon, 14. VIII. 1997; 1W, Mt. Jiri, ? VIII. 1959; 3W, ditto, 15-17. VII. 1968; 5W, ditto, 9. VII. 1969; 1W, ditto, 17. VII. 196?; 1W, ditto, 6. VI. 1970; 25W, ditto, 25-28. VII. 1973; 1W, ditto, 10. VIII. 1973; 8W, ditto, 16-17. VII. 1976; 12W, ditto, 10. VIII. 1978; 1W, ditto, 25. VII. 1993; 1W, ditto, 27. V. 1997; 1W, ditto, 31. VII. 1997; 1Q, Seungju, 15. VIII. 1994. North Korea- 2Q, Mt. Baegdu, 22. VII. 1985; UL- 1Q, ?, ?; 1W, Soseong-ri, 13. VIII. 1995; 1M, ? CIS: GW- 2W, Chuncheon, 3-10. VI. 1980; 1W, ditto, 9. VII. 1980; 1Q, ditto, 21. V. 1981; 1W, ditto, 28. V. 1982; 6W, ditto, 6-28. V. 1983; 1Q, ditto, 14. VI. 1983; 3W, ditto, 8-16. VII. 1983; 2W, ditto, 12-20. X. 1984; 2Q, ditto, 4-14. V. 1985; 1Q, ditto, 6. VI. 1985; 2W, ditto, 17-20. V. 1989; 3W, ditto, 2-17. VI. 1989; 3Q, ditto, 5-21. V. 1990; 4Q, ditto, 2-15. VI. 1990; 2Q, ditto, 20-23. V. 1991; 1Q, 2W, ditto, 10-29. V. 1992; 2W, ditto, 22-24. VI. 1992; 1Q, ditto, 12. V. 1993; 1Q, ditto, 6. VI. 1993; 3Q, ditto, 9-18. V. 1995; 1Q, ditto, 21. IV. 1995; 1Q, ditto, 5. VI. 1995; 1Q, Donghae, 13. V. 1985; 1W, Noamdong, Kangreung, 18. VII. 1981; 1W, Hoengseongdaem, 17. VII. 1994; 1Q, Weonju, 2W, 30. V. 1982; 1Q, ditto, 24. V. 1991; 1Q, ditto, 25. VI. 199?.

Host flowers. *Impatiens textori* Miguel, *Lespedeza bicolor* Turczaninow, *Hosta lancifolia* Engler, *Capsicum annuum* L., *Spiraea salicifolia* L., *Patrinia villosa* (Thunberg), *Hibiscus syriacus* L., *Lycium chinense* Miller, *Curcubita moschata* Duche, *Leonurus sibiricus* L.

Distribution. Korea (North, South), China (Central, Northeast), Russia (Ussuri), and Japan (Honshu, Kyushu, Shikoku).

Remarks. This species can be easily distinguished from other species of subgenus *Bombus* s. str. by black and well trimmed hairs throughout body dorsally except the terga 4-6. It is one of the common species in South Korea, collected from lowlands to high mountainous area.

***Bombus (Bombus) hypocrita sapporoensis* Cockerell** 삿포로뒤영벌
(Figs 3m-o)

Bombus sapporoensis Cockerell, 1911: 641.

Bombus sapporoensis: Doi, 1938: 35-40 (First record in Korea).

Bombus (Bombus) hypocrita sapporoensis: Ito, 1985: 6.

Specimens examined. NIAST: GG- 1M, Mt. Youngmun, 10. X. 1995. GW- 19W, Hwoengseong (Yongdong Tunnel), 15. VII. 1995 (on *Spiraea salicifolia* L.); 1W, Mt. Odae, 8. VI. 1994; 9W, 5M, ditto, 12. VII. 1995 (on *Lespedeza bicolor* Turczaninow, *Ligustrum obtusifolium* S. et Z., and *Raphanus sativus* L.); 1W, 3M, ditto, 14. X. 1995 (on *Saussurea pulchella* Fischer); 2W, Osaek, Mt. Seolag, 9. VI. 1994; 2W, Pyoungchang 11. IX. 1993; 11W, Mt. Taebaek, 15. VIII. 1989. JN- 1W, Mt. Jiri (Simwon), 30. VIII. 1995 (on *Impatiens textori* Miguel); North Korea- 1W, Yutenji (Yujeomsa, Mt. Geumgang), 21. VII. 1924. SNU: GW- 12W, Bongpyung, 20. VIII. 1997; 1W, Oak Valley, Wonju, 18. VIII. 1997; 16W, Weoljunga, Mt. Odae, 10. V. 1997. CB- 2W, Mt. Sobaek, 12-13. VIII. 1992. JN- 1W, Piagol, Mt. Jiri, 7. VII. 1997 UL- 5W, ?.

Distribution. Korea (North, Central, South), China (Northeast), Russia (Ussuri, Sakhalin), and Japan

Host flowers. *Lespedeza bicolor* Turczaninow, *Saussurea pulchella* Fischer, *Spiraea salicifolia* L., *Raphanus sativus* L., *Impatiens textori* Miguel, *Ligustrum obtusifolium* S. et Z.

Remark. This species may prefer the mountainous regions to the lowlands. Among the species of subgenus *Bombus*, *B. hypocrita sapporoensis* is similar and often confused with *B. patagiatus* and *B. sporadicus czerskianus*, but it can be distinguished by the following characters; white area of collar narrower than in other species and scutellum and tergum 1 is black.

***Bombus (Bombus) patagiatus patagiatus* Nylander** 잔털뒤영벌
(Fig. 2m)

Bombus patagiatus Nylander, 1848: 234.

Bombus patagiatus brevipilosus: Bischoff, 1936: 1-27 (First record in Korea).

Bombus (Bombus) patagiatus patagiatus: Sakagami, 1975: 306.

Specimens examined. NIAST: GG- 1Q, Suwon, 2. VI. 1959. CIS: GW- 1Q, Chuncheon (Kukokpokpo), 23. V. 1991. ITOC: North Korea- 1W, Mt. Pektusan 1900 m, Prov. Ryang-gang, 28. VIII. 1971; 1W, Samsiyan 1700 mm, Plateau Chann-Pay, Prov. Ryang-gang, 27. VIII. 1971.

Distribution. Korea (North, Central), Russia (South Siberia south of about 60° North Ussuri, Sakhalin). Europe, Mongolia, and China (Central including Gansu and Kukuinor, Northeast).

Remarks. This species has been previously recorded from the northern part of Korea, near the border to China, by Sakagami (1975) and Ito (1985). This species is very similar to *B. (Bombus) sporadicus* in coloration, but has more white hairs on collar, scutellum, tergum 1 and terga 5-6; ventral hairs of thorax and abdomen as well as part of femur white instead of dark brown or black as in *B. sporadicus*. This is

the first record of this species in S. Korea.

Bombus (Bombus) sporadicus czerskiadicus Vogt 제르스키뒤영벌

Bombus (Terrestribombus) terrestris var. *czerskianus* Vogt. 1911: 56.

Bombus (Bombus) sporadicus czerskianus: Sakagami, 1975: 307 (First record in Korea).

Specimen examined. ITOC: North Korea- 1W, Mt. Pektusan 1900 m, Prov. Ryang Gang, 28. VIII. 1971.

Distribution. Korea (North), Russia (Siberia, RFE), Fennoscandia, Mongolia, and China (Central including Kukulnor).

Remarks. In addition to the differences mentioned in the previous remarks, this species has more yellowish white hairs on collar, scutellum and T1-T2. This species was reported from the same places as the previous species of the subgenus by Sakagami (1975) and Ito (1985).

Bombus (Bombus) cryptarum (Fabricius) 노랑띠뒤영벌

Apis cryptarum Fabricius, 1775: 379.

Bombus albocinctus Doi (nec Smith), 1938: 35-40 (First record in Korea).

Bombus (Bombus) cryptarum: Kim et Ito, 1987: 8.

Specimens examined. No Korean specimen.

Distribution. Korea (North) and Russia (RFE).

Remark. After the first record of Doi (1938), no specimens have been collected in the Korean peninsula.

DISCUSSION

As shown in Table 1, among the 21 Korean bumblebee species, only 15 species are confirmed to be distributed in South Korea, while all the species have been recorded from North Korea. The main reason is that the North Korean fauna has been studied relatively well by Sakagami (1975) and Ito (1985), and the 6 species absent from South Korea are of northern origin and probably reach their southern most range in the northern part of the Korean Peninsula, in accordance to the result of Sakagami (1975) and Ito (1985). However, it can be expected that some more northern and southern forms of Eurasian species might be found in the high mountains of central Korea. On the other hand, the bumblebee fauna of Korea is closely related to that of China and Russian Far East rather than that of Japan.

It has also been shown that *B. ardens* and *B. consobrinus wittenburgi* are abundant only in the southern part of Korean Peninsula, while *B. ignitus*, *B. hypocrita* and *B. ussuriensis* are abundant in both North and South. (according to the results of Sakagami (1975), Ito (1985) and Kim (1987). It is considered that further investigations focused on the mountainous area in the central Korea are needed

Table 1. Distributional data of the Korean *Bombus* species.

Scientific name	Location		JP	CH	RU	EU	
	S	N					
Subgenus <i>Megabombus</i>							
☆ <i>B. (Megabombus) consobrinus wittenbutgi</i>	0	0	0	0	0	0	
☆ <i>B. (Megabombus) koreanus</i>	0	0					
<i>B. (Megabombus) czerskii</i>		0		0	0		
Subgenus <i>Diversobombus</i>							
☆ <i>B. (Diversobombus) ussuriensis</i>	0	0	0	0	0		
Subgenus <i>Thoracobombus</i>							
☆ <i>B. (Thoracobombus) opulentus</i>	0	0		0			
<i>B. (Thoracobombus) schrenki albidoplenralis</i>	0	0	0	0	0	0	
<i>B. (Thoracobombus) pascuorum flavobarbatus</i>		0		0	0	0	
** <i>B. (Thoracobombus) humilis subbaicalensis</i>	0	0		0	0	0	
<i>B. (Thoracobombus) pseudobaicalensis</i>		0	0	0	0		
<i>B. (Thoracobombus) anachoreta</i>	0	0			0		
Subgenus <i>Tricornibombus</i>							
<i>B. (Tricornibombus) tricornis</i>	0	0		0	0		
* <i>B. (Tricornibombus) atripes</i>	0	0		0			
Subgenus <i>Melanobombus</i>							
<i>B. (Melanobombus) sicheli sicheli</i>	0	0		0	0	0	
Subgenus <i>Pyrobombus</i>							
☆ <i>B. (Pyrobombus) ardens ardens</i>	0	0	0				
<i>B. (Pyrobombus) hypnorum calidus</i>		0	0		0	0	
<i>B. (Pyrobombus) modestus</i>	0	0			0		
Subgenus <i>Bombus</i>							
☆ <i>B. (Bombus) ignitus</i>	0	0	0	0	0		
☆ <i>B. (Bombus) hypocrita sapporensis</i>	0	0	0	0	0		
<i>B. (Bombus) patagiatus patagiatus</i>	0	0		0	0	0	
<i>B. (Bombus) sporadicus czerskiadicus</i>		0		0	0	0	
<i>B. (Bombus) cryptarum</i>		0			0		
Total	21 species	15	21	8	15	17	8

• : New to Korean Peninsula, •• : new to South Korea, ☆ : abundant in South Korea, S: South Korea, N: North Korea, JP: Japan, CH: China, RU: Russia, EU: Europe.

for more information about bumblebee distribution in Korea.

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韓國產 뒤영벌屬 (벌目, 꿀벌科)의 分類學的 再檢討

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국내 관련 연구소 및 대학 등에 所藏된 標本과 一部 北韓產 標本 등을 대상으로 分類同定한 結果 총 17種이 確因되었다. 이 중 *Bombus* (*Tricornibombus*) *atripes*는 韓半島에서 처음 記錄하며 *B. (Thoracobombus) humilis subbaicalensis* Vogt는 南韓에서 처음으로 記錄한다. 이들을 포함한 韓半島產 7亞屬 21種에 대한 檢索表와 採集記錄, 각 種의 寄主 開花植物에 대하여 記述하였다.

검색어 : 분류, 벌목, 꿀벌과, 뒤영벌속, 한국

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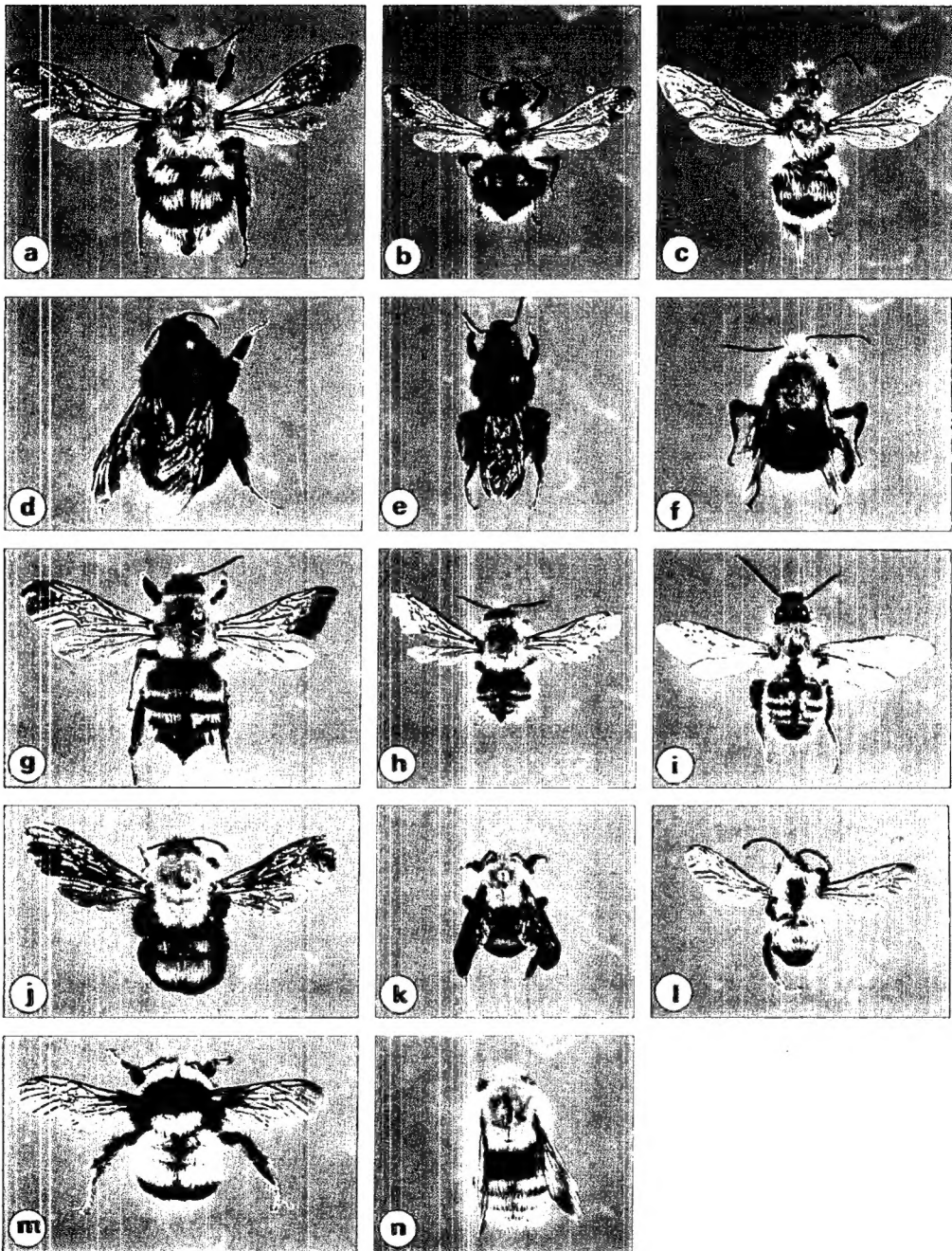


Fig. 2. Queen, worker and male of *Bombus* spp.

B. (Megabombus) consobrinus wittenburgi (Vogt) (a. queen, b. worker, c. male);

B. (Megabombus) koreanus (Skorikov) (d. queen, e. worker, f. male);

B. (Diversobombus) ussuriensis Radoszkowski (g. queen, h. worker, i. male);

B. (Thoracobombus) opulentus Smith (j. queen, k. worker, l. male);

B. (Bombus) patagiatus patagiatus Nylander (m. queen);

B. (Thoracobombus) schrencki albidopleuralis Skorikov (n. worker).

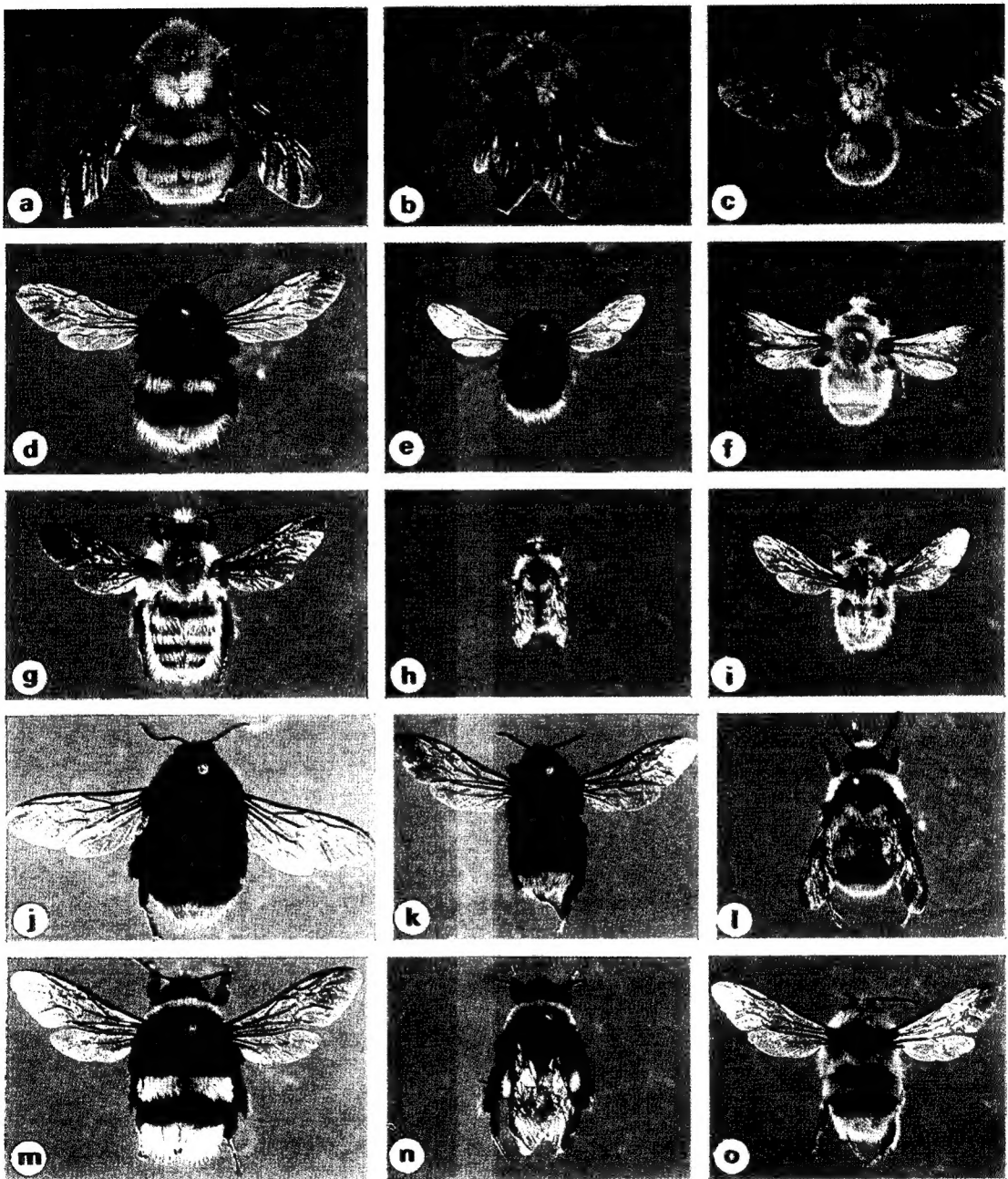


Fig. 3. Queen, worker and male of *Bombus* spp.

- B. (Tricornibombus) atripes* (Smith) (a. queen, b. worker, c. male);
B. (Pyrobombus) ardens ardens Smith (d. queen, e. worker, f. male);
B. (Pyrobombus) modestus Eversmann (g. queen, h. worker, i. male);
B. (Bombus) ignitus Smith (j. queen, k. worker, l. male);
B. (Bombus) hypocrita sapporoensis Cockerell (m. queen, n. worker, o. male).